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## (54) A Method of Manufacturing Nails

(57) A method for the manufacture of nails of the type which have along at least the major portion of the nail shank tapered protrusions of which the narrow ends are directed towards the nail tip, and which are preferably disposed helically around the nail shank comprises the steps of rolling an elongated blank in a first rolling step to impart to it a cross-sectional shape comprising a plurality of circumferentially spaced lobes, depressing these lobes in a second rolling step while simultaneously forming the tapered protrusions and reducing the cross-sectional area of the blank by using rolls (20, 21) whose operative surfaces have die matrix cavities corresponding to the tapered protrusions, and cutting the rolled blank into nails which are provided with a head.

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

Fig. 1

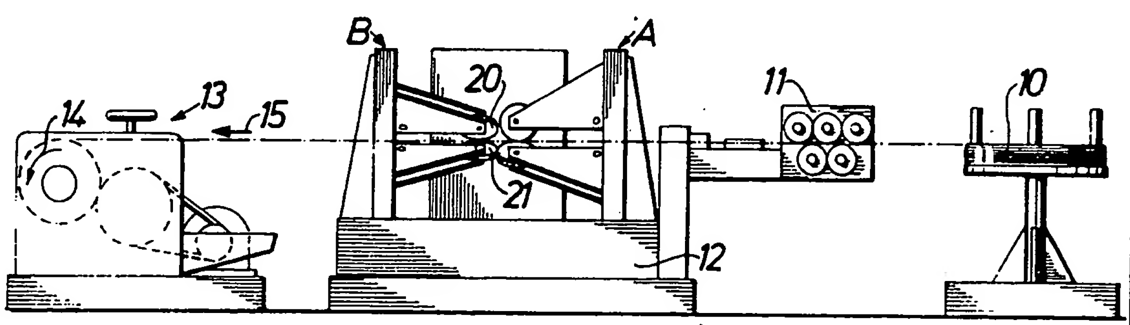


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Fig.1

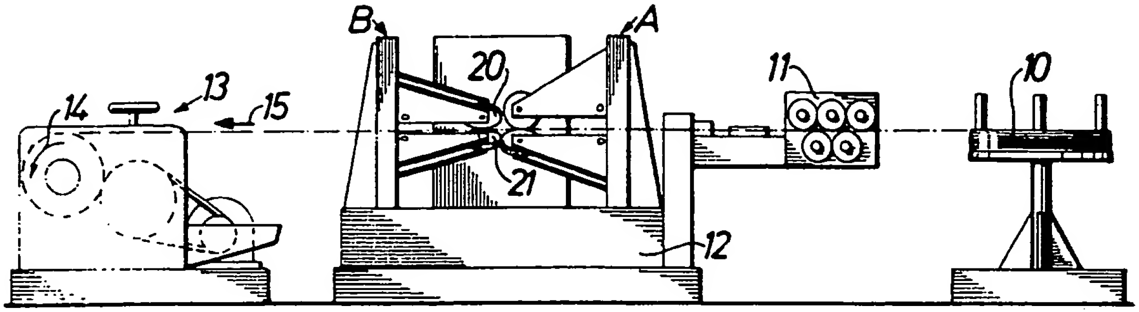



Fig. 2

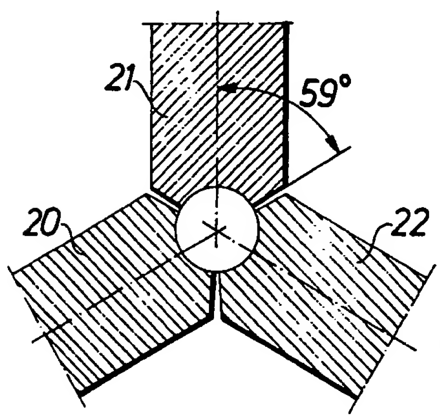



Fig.3

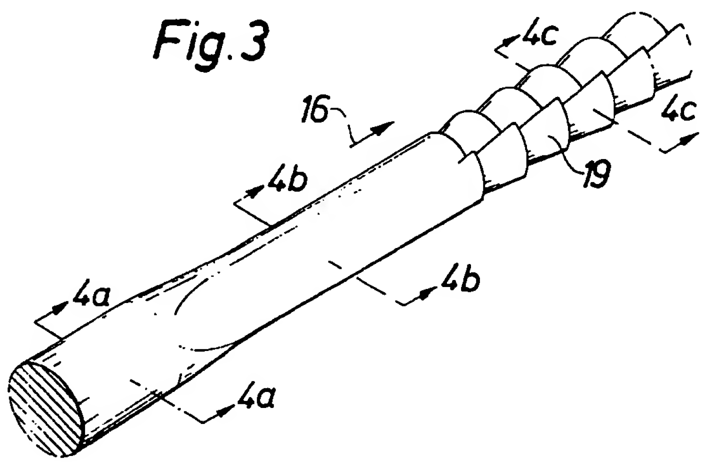



Fig.4a

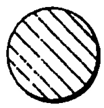


Fig.4b

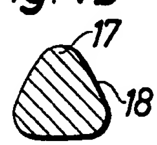



Fig.4c

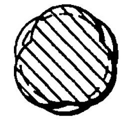


Fig.5

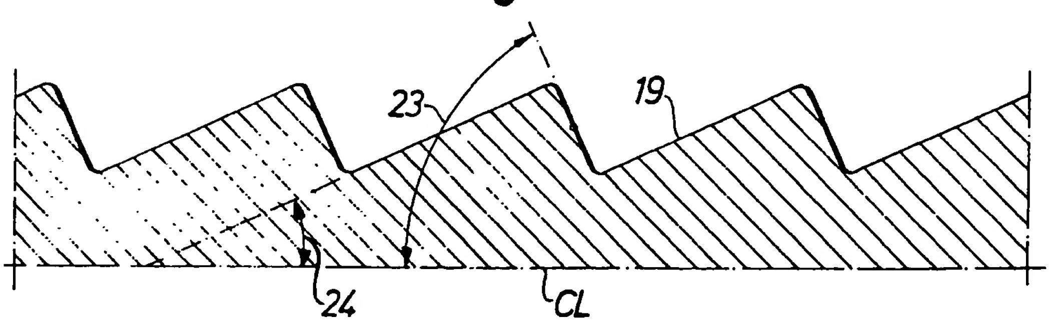


Fig. 6

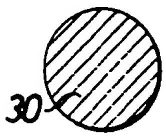



Fig. 6a

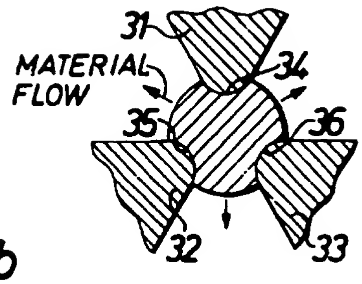



Fig. 7

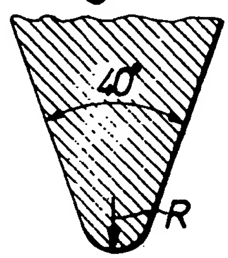



Fig. 6b

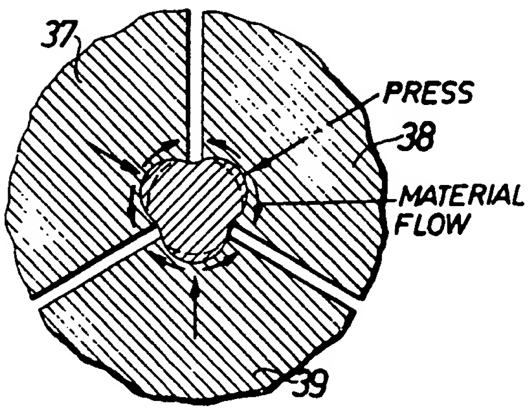
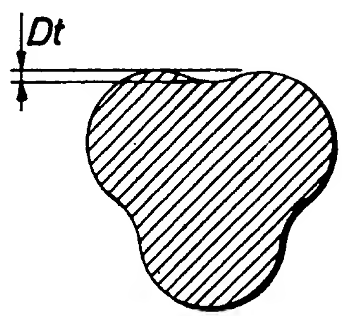



Fig. 7a




| THREAD BLANK DIAMETER M/M | RADIUS R | DEPTH $D_t$ |
|---|---|---|
| 2.1<br>2.5 | 0.4 | 0.15 |
| 2.8<br>3.1 | 0.6 | 0.30 |
| 3.4<br>3.7 | 0.8 | 0.50 |
| 4.0<br>4.3 | 1.0 | 0.65 |

SPECIFICATION

**A Method of Manufacturing Nails**

In connection with the manufacture of nails a plurality of different expedients have been taken already previously in order to increase the nail holding force. As examples of such expedients it should be mentioned that nails have been provided with a cut surface, with a profiled surface, with a cam surface, and that the centre nail shank has been twisted. These expedients in order to increase the holding force have largely been taken with little or no attention paid to what actually happens when the nails are driven into the wood, i.e. the action of the nails on the wood fibres, and the reaction of the wood fibres against the nail surface, particularly their ability to engage with the nail shank, as the nail joint strives to "live" due to varying load, weather conditions and so forth.

One nail design has been proposed which exhibits a very high holding force, even when it has been in position for a very long time. This type of nail is characterized by the fact that the nail shank, along the major portion of its length or along its full length, has tapered protrusions, the narrower ends of which are directed toward the nail tip and which are so spaced circumferentially and longitudinally of the nail shank that the cross-section of the nail shank is substantially constant along the full length of the nail shank. Such nails may be manufactured by a cold-heading operation, utilizing cold-heading dies which are pressed with very high force against a thread shaped blank from the sides thereof so as to form the protrusions in a sort of coining operation. Such a cold-heading operation affords certain advantages with respect to the final product but in practice it is so expensive that it cannot be utilized in view of the end price of the final product.

The present invention aims at providing a method for the manufacture of nails of the above generally designated type at a comparatively low price, whilst at the same time achieving certain advantages with respect to the quality of the final product.

To the above mentioned end it is proposed according to the present invention that the manufacture should be carried out in the manner defined in the characterizing clause of claim 1 appended to this specification.

The invention will be hereafter disclosed in more detail with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic overall view of a rolling mill utilized for the manufacture of nails in accordance with the present invention;

Figure 2 is a diagrammatic partial view of three mutually cooperating rollers of the rolling mill.

Figure 3 is a diagrammatic perspective view of an elongated nail blank during the manufacture;

Figures 4*a*, 4*b* and 4*c* are diagrammatic cross-sections of the blank in Figure 3 in the planes 4*a*—4*a*, 4*b*—4*b* and 4*c*—4*c*, respectively, in Figure 3;

Figure 5 shows diagrammatically and to an enlarged scale one portion of an axial length section of a final rolled nail blank;

Figures 6, 6*a* and 6*b* are diagrammatic cross-sections of a nail blank, a first rolling step of a different method, and a second rolling step of the same method, respectively;

Figures 7 and 7*a* are a partial cross-section of a roller edge portion and a section of an intermediary blank, formed in the first step as shown in Figure 6*a*, respectively.

Figure 1 shows diagrammatically a thread rolling installation comprising a storage reel 10, a straightening machine 11, a profile rolling mill 12, having two roll stands A and B, a power reel stand 13, and a coiling drum 14. The elongated nail blank passes through the installation in the direction indicated by the arrow 15 in Figure 1. The same treatment direction is indicated by the arrow 16 in Figure 3.

With special reference to Figures 1 and 3 the rolling operation is performed as follows:

The thread shaped raw material, which is preferably of circular cross-section, Figure 4*a*, passes from the straightening machine 11 into the first roll stand A of the rolling mill 12 wherein it is given a cross-section comprising as plurality of circumferentially spaced lobes 17 (in this case three) which are mutually spaced by essentially straight cross-section border lines 18, (Figure 4*b*). During this rolling step there occurs as plastic material flow within the blank, on one hand laterally and on the other hand longitudinally, which material flow thus manifests itself in a change of the cross-sectional shape and also in an elongation of the thread blank, corresponding to a cross-sectional area reduction of the order of 10—20%, preferably about 15%.

Then, under engagement with the lobes 17, the second rolling step is performed in the rolling stand B, whereby tapered protrusions 19 are formed by operation of rolls 20, 21, 22, (Figures 1 and 2), the mutually facing envelope surfaces of which are provided with die matrix cavities of a shape corresponding to the shape of the tapered protrusions 19. Also in this case a certain cross-sectional area reduction occurs, viz. of the order of 10—20%, preferably about 15%. In this step it is essential that the rolls 20, 21, 22 rotate synchronously and have their die matrix cavities designed and disposed in such a manner that the cross-sectional area of the blank (after the roll stand B) is essentially constant along the full length of the blank, irrespective of where the section is taken, whereby however the actual shape of the cross-section varies in dependence upon the tapered protrusions.

Figure 5 illustrates diagrammatically a partial longitudinal section of the nail blank and shows

details of the shape of the tapered protrusions. It should be noted that the angle 23 between the rear end of the tapered protrusion and the centre line CL is between 75° and 90°, preferably about 85°, whereas the taper angle 24 between the protrusion surface and the centre line CL of the blank is 5°—15°, preferably about 10°.

With reference particularly to Figure 2 it should be noted that the peripheral edge portion of the profile rolls 20, 21, 22 do not fill the cross-section entirely but have a half angle of conicity of 59° so as to afford certain possibilities of adjustment.

Modifications and alterations as to details may be performed within the scope of the invention.

Thus, as shown in Figures 6 to 6*b* it is also possible to subject a thread blank 30 of at least substantially circular cross-section to a longitudinal fluting or grooving step, Figure 6*a*, by means of three or any other convenient number of rollers 31, 32, 33 which are evenly spaced circumferentially. These rollers elongate the thread blank and give rise to longitudinal superficial zones which are hardened due to the rolling action thereon. Then, the blank is further rolled, in a second rolling step, by means of matrix rollers 37, 38, 39, Figure 6*b*, which are similar to the above described rollers. The rolling operation of the second step, Figure 6*b*, is performed in such a manner that the flute surfaces 34, 35, 36 almost revert to a flat or outwardly bulging configuration.

As compared with the first embodiment this second embodiment results in a much higher material flow, a higher hardening of the material by rolling and a substantially higher material yield, i.e. an increased quantity of nails of improved performance per kg of raw material.

Above, it has been mentioned that the blanks should be area-reduced and elongated. These parameters may be calculated as follows:

R=Area *reduction* in %
LR=*Elongation*, due to area reduction
F1=Area of *in*going thread blank
F2=Area of *out*going thread blank
V1=Incoming volume
V2=Outgoing volume
D1=Ingoing diameter
D2=Outgoing diameter

**Area Reduction**

$$R=\frac{F1-F2}{F1}\times 100=\ldots\ \%\ \text{reduction}$$

**Elongation**

$$V1=V2\times LR$$

$$LR=\frac{V1}{V2}=\frac{D1^2\times\pi/4\times L}{D2^2\times\pi/4\times L}=\frac{D1^2}{D2^2}=\ldots\ \%$$

**Example**

Ingoing thread blank 5.0 mm diameter
Outgoing thread blank 4.5 mm diameter

$$R=\frac{19.6-16}{19.6}\times 100=18.3\%\ \text{reduction}$$

$$\text{Elongation } LR=\frac{5^2}{4.5^2}=\frac{25}{20.25}=1.234=23.4\%$$

In the above, it has been assumed that an essentially circular cross-sectioned thread blank is used. Of course, if it is feasible to start with a thread with longitudinal flattened or fluted surface areas, and adopt only the second rolling step as described above this would still fall within the scope of the present invention.

**Claims**

1. A method for the manufacture of nails of the type which have along at least the major portion of the nail shank tapered protrusions of which the narrow ends are directed toward the nail tip and which are preferably disposed along a helix around the nail shank comprising the steps of

rolling an elongated blank (preferably of circular cross-section) in a first rolling step to impart to said blank a cross-sectional shape comprising a plurality of circumferentially spaced lobes,

depressing said lobes in a second rolling step while simultaneously forming the tapered

protrusions and reducing the cross-sectional area of the blank while using rolls of which the envelope surfaces have die matrix cavities corresponding to the tapered protrusions, the spacing between the die matrix cavities of the rolls of the second step being such that the cross-sectional area of the final rolled blank is essentially constant at each point along the length of the blank, and

cutting the rolled blank into nails which are provided with a head.

2. A method as claimed in claim 1 wherein the elongated blank in the first rolling step is area reduced in the order of 10—20%, preferably about 15%.

3. A method as claimed in claim 1 wherein the area reduction in the first rolling step is caused by rolling out flat surface zones between the lobes.

4. A method as claimed in any of claims 1 to 3 wherein the blank in the first rolling step is formed into a substantially triangular cross-sectional shape, comprising three lobes which are spaced apart by essentially straight cross-sectional border lines.

5. A method as claimed in any of claims 1 to 4, wherein the second rolling step comprises an area reduction of 10—20%, preferably about 15%.

6. A method as claimed in any of claims 1 to 5 wherein there is imparted to the tapered protrusions in the second rolling step a shape corresponding to an angle of 75—90°, preferably about 85°, between the rear ends of the tapered protrusions and the centre line of the blank.

7. A method as claimed in any of claims 1 to 6, wherein there is imparted to the tapered protrusions in the second rolling step a shape corresponding to an angle of 5—15°, preferably about 10°, between the tapered surfaces of the protrusions which are directed toward the nail tip, and the centre line of the nail.

8. A nail having along the full length or the major portion of the nail shank protrusions which taper toward the nail tip and which are disposed along a screw line (helix) around the nail shank

wherein between circumferentially adjacent protrusions narrow longitudinal surface zones are formed and are hardened by rolling the blank between circumferentially evenly spaced, radially working rollers.

9. A nail as claimed in claim 8 wherein the longitudinal surface zones are the bottom surface zones of longitudinal flutes.

10. A nail as claimed in claim 8 wherein the longitudinal surface zones merge smoothly with the protrusion-carrying surface zones.

11. A nail as claimed in claim 8 wherein the longitudinal surface zones are reset to substantially the same outer shape as the protrusion carrying surfaces.

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